

September 24, 1996

Memorandum for the Record

To: Distribution
From: Jim Haas, U.S. Fish and Wildlife Service
Subject: Ecological Relevance of Reduced Egg Production

A Toxicological Reference Value (TRV) for lead effects on birds was developed by the Biological Technical Advisory Group (BTAG) based on the effects of lead on egg production in Japanese quail. A question has arisen in the Presidio of San Francisco ecological risk assessment regarding the ecological significance of reduced egg production as an assessment endpoint, since birds sometimes lay more eggs than can be successfully hatched and fledged given available food supplies.

Clutch size in birds seems to be controlled by a variety of extrinsic and intrinsic factors, some of which are species-specific. Clutch size in some species does not vary; some produce only a single egg per year, and the ecological implications of decreased egg production are obvious. In many other species clutch size varies between seasons and between breeding events (for species that double clutch), and more eggs are produced than survive to hatching or fledging. In either case, however it has to be assumed that the number of eggs produced is at least sufficient for parents to replace themselves in the population or the species would be extinct.

Eggs are produced at a significant energetic cost to the female bird. Some lose as much 50% of their body weight during laying. Given this cost, there must be an adaptive advantage to seeming overproduction, otherwise the number of eggs produced would be limited by evolutionary selection to the number that could be successfully hatched and fledged.

The most likely theory for egg "overproduction" in birds is related to the variability of food resources. Food supplies vary seasonally, and bird fledging success can vary in response. "Overproduction" allows birds to exploit seasons with abundant food by fledging more offspring. This helps compensate for poor years when production is low. The inability to exploit these good years due to decreased egg production could therefore drive mean bird productivity down over time. Such a decrease in productivity might have several adverse effects. At the individual level, physiological impairment that decreases egg production might also make birds more susceptible to other stressors, such as cold, wet weather, predation, and habitat alteration, that are also known to affect egg production and fledging success. At the population level, a given population could drop below its minimum viable population size, resulting in extinction from the effects of catastrophic manmade or stochastic events.

Based on the foregoing, egg production seems like an entirely appropriate endpoint for evaluating the ecological effects of contaminants on birds.

If you have any questions or comments please call me at (916) 979-2112 x 410.

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